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United Kingdom

(54) Abstract Title
Trainable transmitter for transmitting an rf signal including a personal identification code

(57) A trainable transmitter is trained to learn the RF carrier frequency and code of a training signal transmitted from a separate transmitter. where the code included in the training signal is a unique personal identification code associated with an individual. The RF signal transmitted from the trainable transmitter including the learned RF carrier frequency and personal identification code, is received by a receiver that analyzes the received personal identification code and responds thereto by performing a specific task relative to the individual identified in the personal identification code. The receiver to which the trainable transmitter transmits the learned RF signal may be a receiver installed in a security system in a parking location, along a toll road or bridge, or in a drive-through station of a service center, such as a restaurant or gas station. The trainable transmitter may be installed in a vehicle 55 or provided in a key fob or identification card.

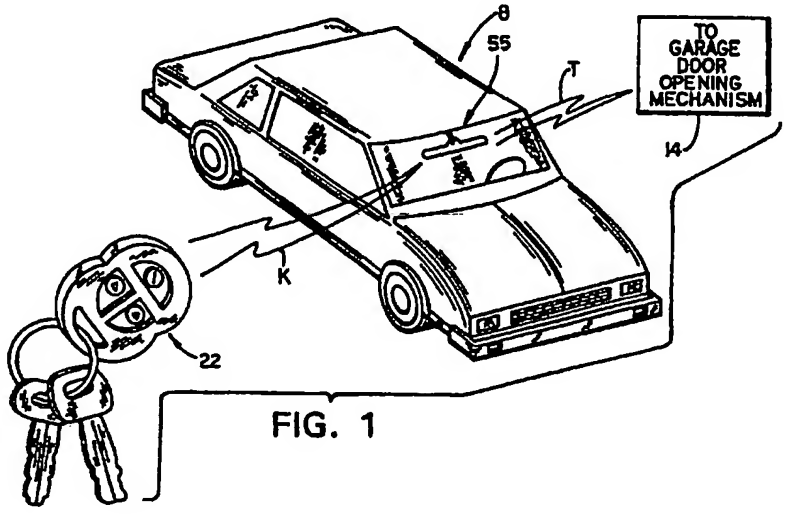


FIG. 1

GB 2 325 552 A

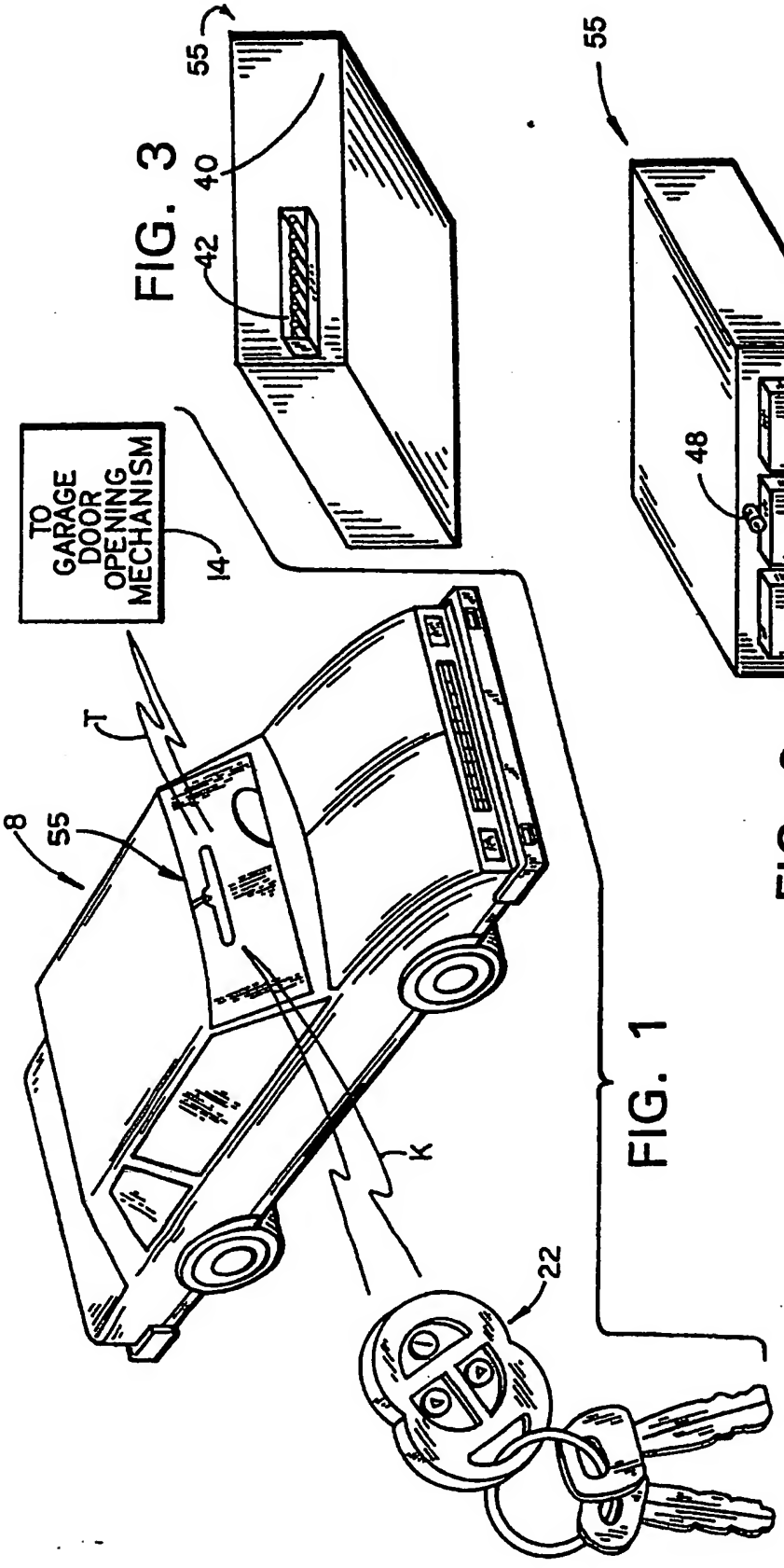


FIG. 3

FIG. 2

FIG. 1

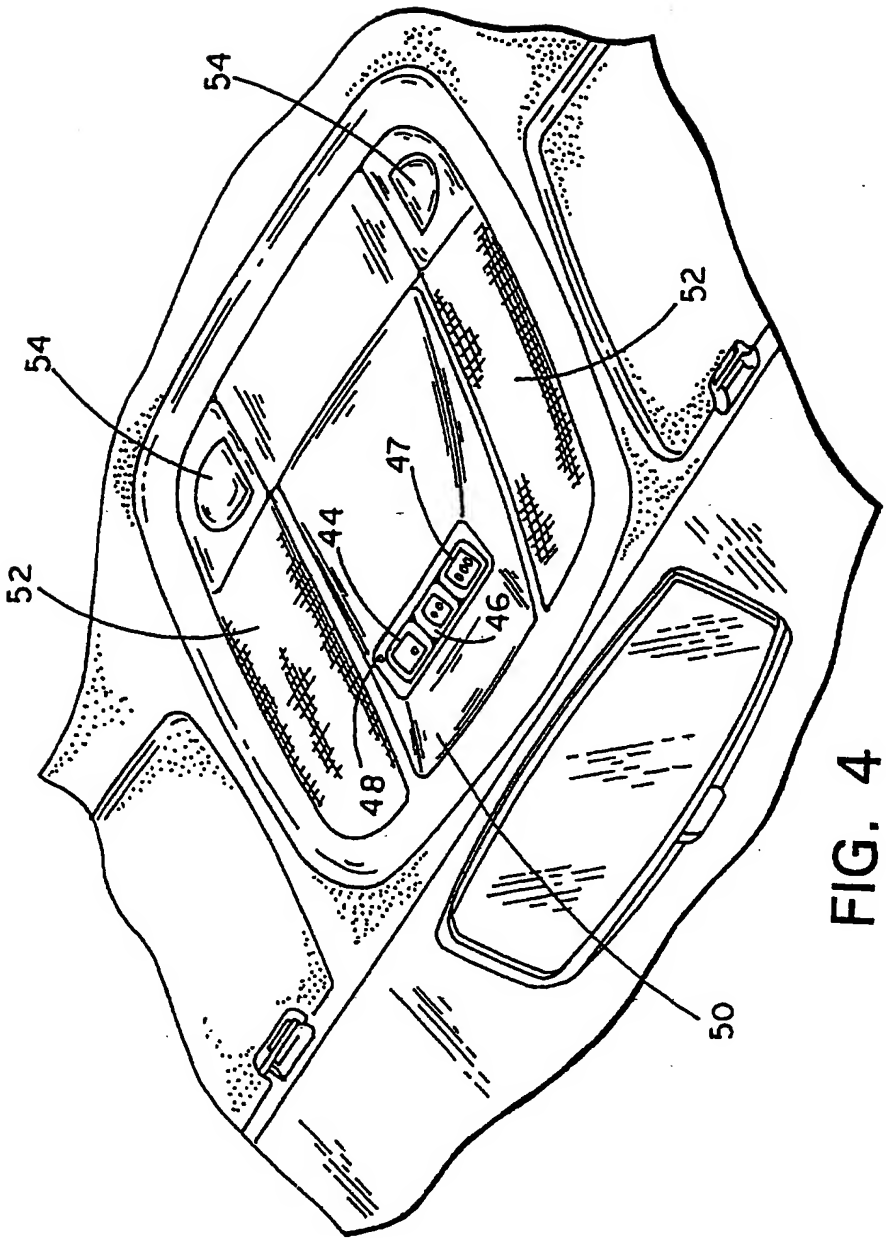


FIG. 4

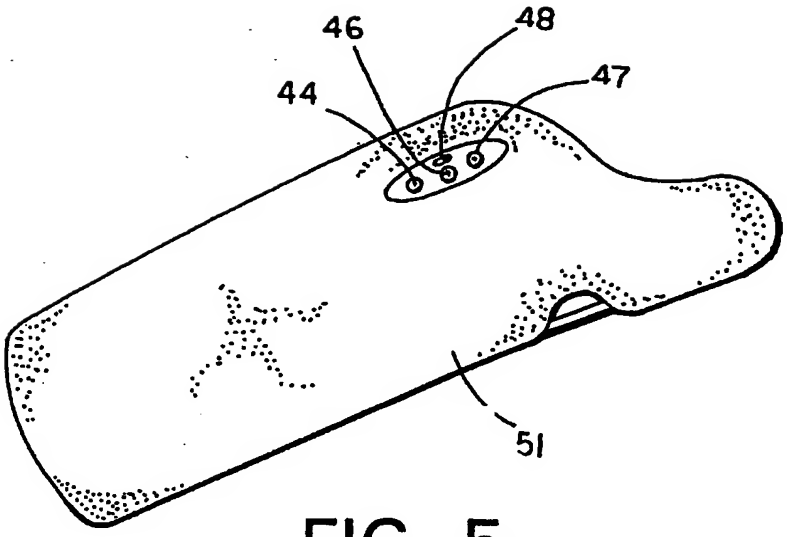


FIG. 5

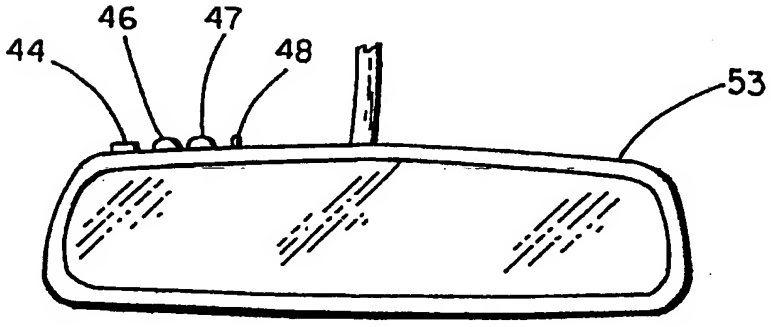
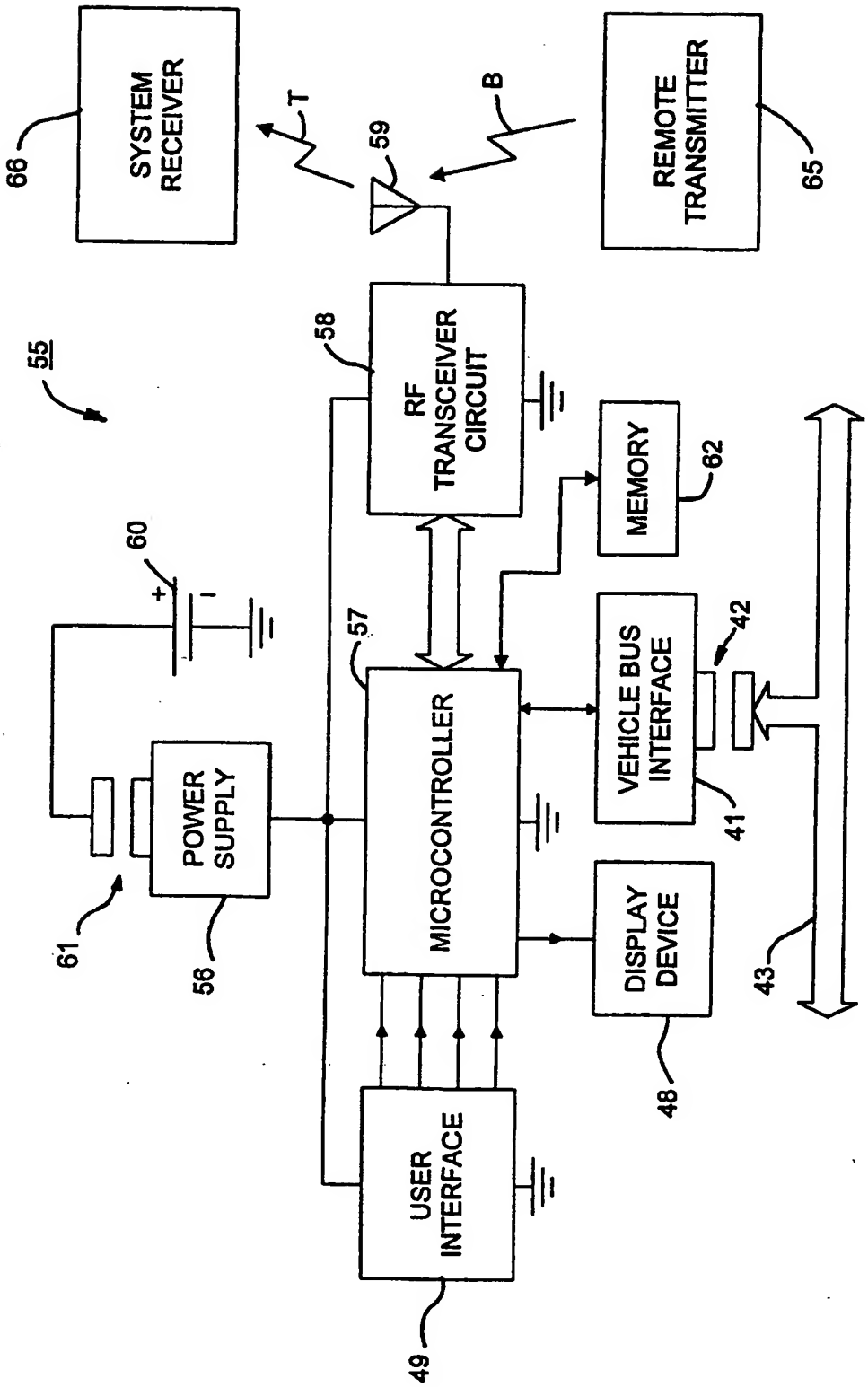


FIG. 6

FIG. 7


55
SYSTEM RECEIVER
66
T
59
B
REMOTE TRANSMITTER
65
RF TRANSCEIVER CIRCUIT
58
MEMORY
62
60
+
-
57
VEHICLE BUS INTERFACE
42
41
POWER SUPPLY
61
56
MICROCONTROLLER
DISPLAY DEVICE
48
43
USER INTERFACE
49

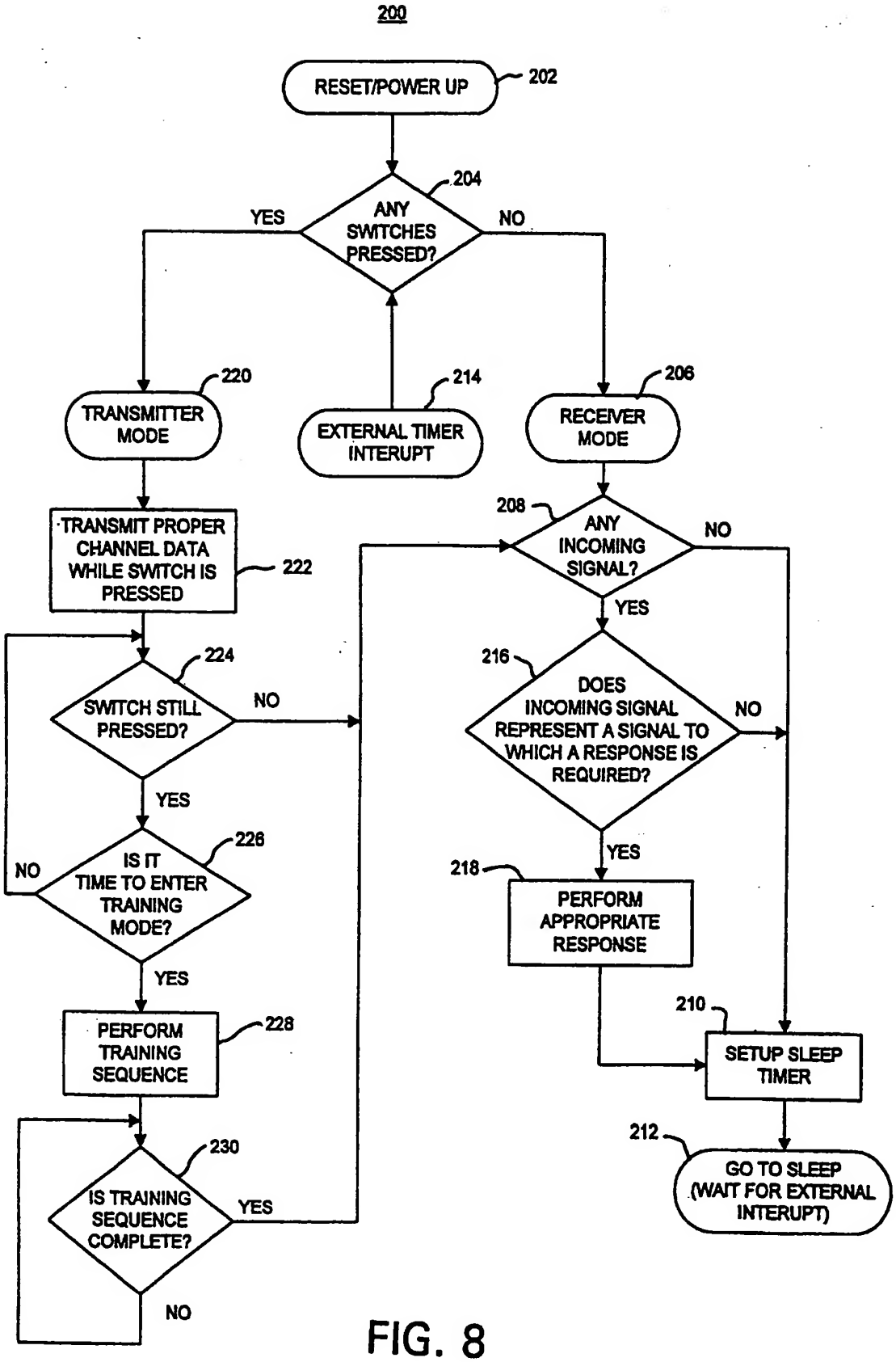

200
RESET/POWER UP
202
ANY SWITCHES PRESSED?
204
YES
NO
TRANSMITTER MODE
220
EXTERNAL TIMER INTERUPT
214
RECEIVER MODE
206
TRANSMIT PROPER CHANNEL DATA WHILE SWITCH IS PRESSED
222
ANY INCOMING SIGNAL?
208
NO
YES
SWITCH STILL PRESSED?
224
NO
YES
DOES INCOMING SIGNAL REPRESENT A SIGNAL TO WHICH A RESPONSE IS REQUIRED?
216
NO
YES
IS IT TIME TO ENTER TRAINING MODE?
226
NO
YES
PERFORM APPROPRIATE RESPONSE
218
PERFORM TRAINING SEQUENCE
228
SETUP SLEEP TIMER
210
IS TRAINING SEQUENCE COMPLETE?
230
YES
NO
GO TO SLEEP (WAIT FOR EXTERNAL INTERUPT)
212

FIG. 8

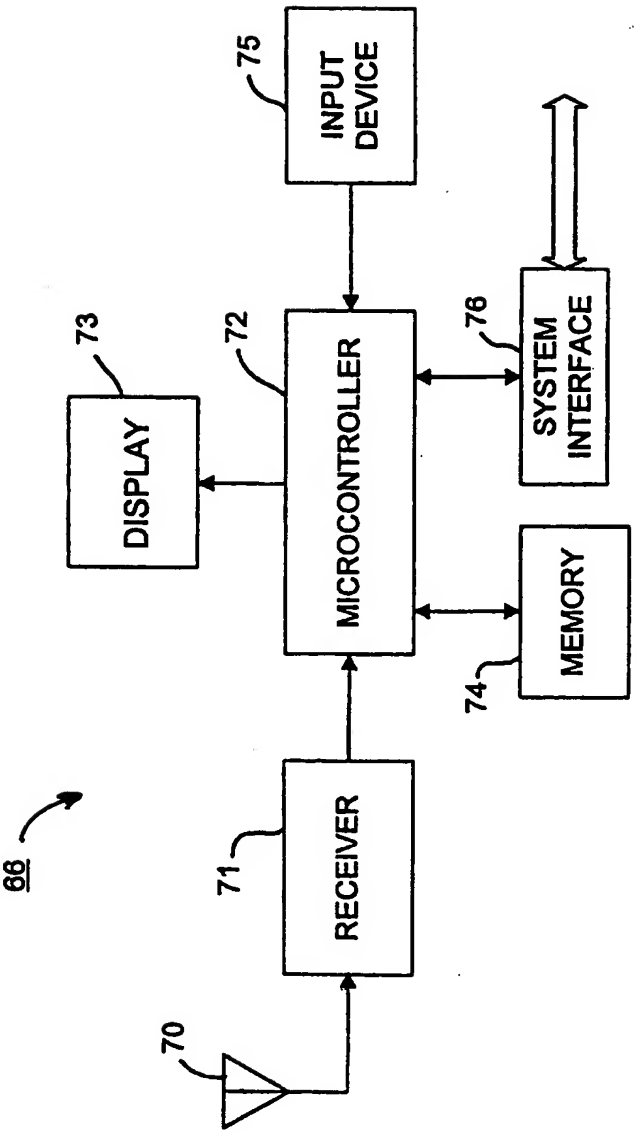

66
70
71
RECEIVER
74
MEMORY
72
MICROCONTROLLER
73
DISPLAY
75
INPUT DEVICE
76
SYSTEM INTERFACE

FIG. 9

FIG. 10

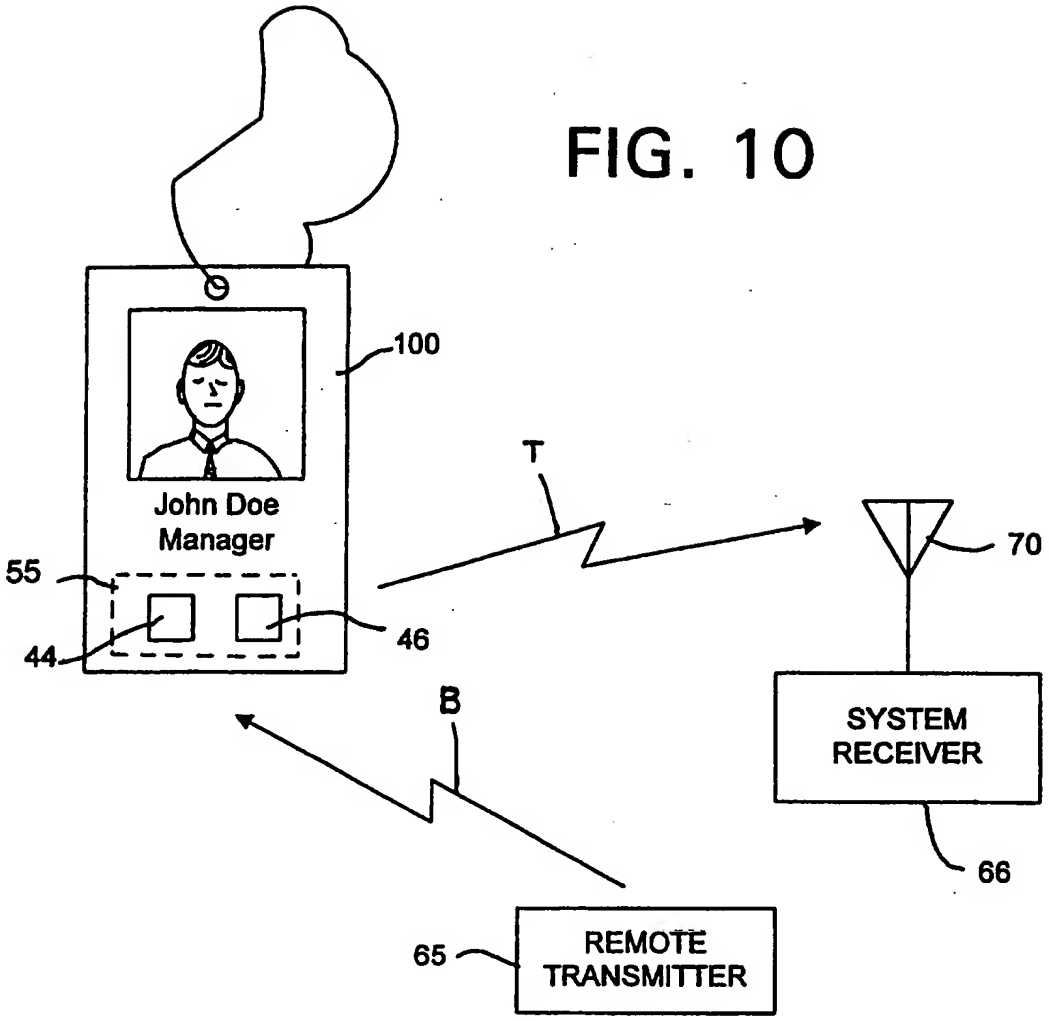

100
John Doe
Manager
55
44
46
T
70
SYSTEM
RECEIVER
66
B
65
REMOTE
TRANSMITTER

FIG. 11

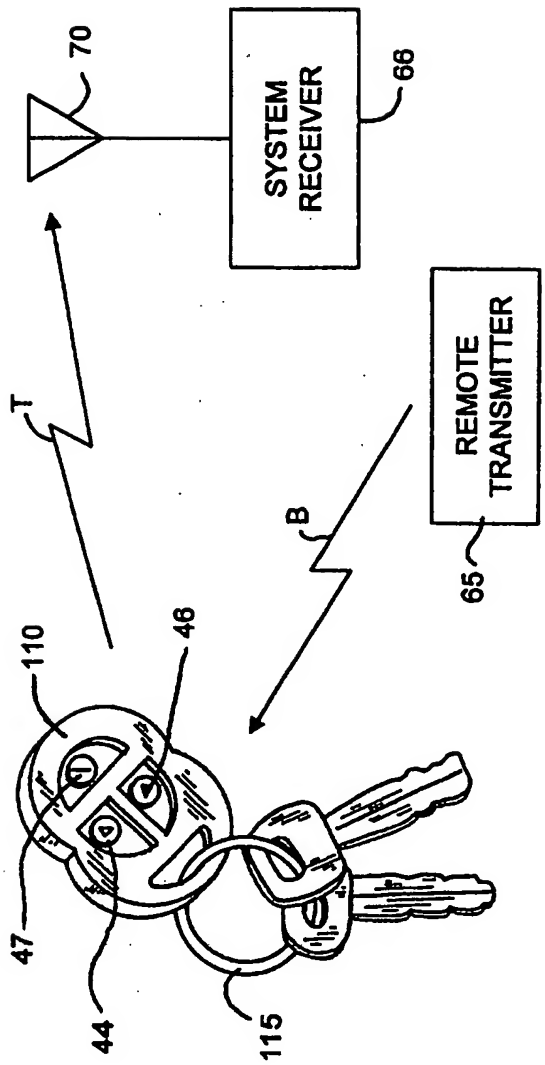
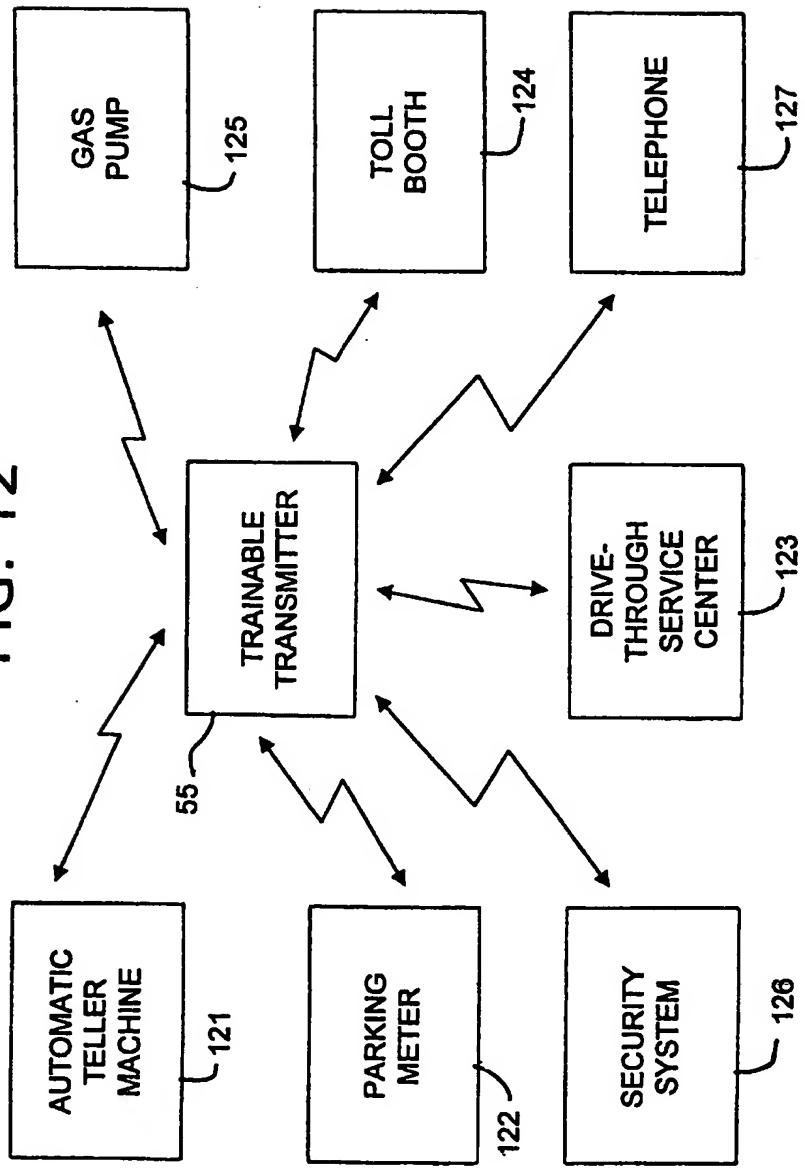

70
SYSTEM RECEIVER
66
T
REMOTE TRANSMITTER
B
65
110
46
47
44
115

FIG. 12


GAS PUMP
125
TOLL BOOTH
124
TELEPHONE
127
TRAINABLE TRANSMITTER
55
DRIVE-THROUGH SERVICE CENTER
123
AUTOMATIC TELLER MACHINE
121
PARKING METER
122
SECURITY SYSTEM
126

TRAINABLE TRANSMITTER SYSTEM AND METHOD OF USING A TRAINABLE TRANSMITTER FOR TRANSMITTING AN RF SIGNAL INCLUDING A PERSONAL IDENTIFICATION NUMBER

BACKGROUND OF THE INVENTION

The present invention generally relates to new systems and methods of using a trainable RF (radio frequency) transmitter for transmitting RF signals including a code representing a personal identification number. More specifically, the present invention relates to security systems and systems for paying fees, such as parking fares, toll fares, and gas and food expenses.

Trainable RF transmitters presently exist that are capable of learning the characteristics (*i.e.*, the RF carrier frequency, code, and modulation scheme) of an RF control signal transmitted from a remote control transmitter, such as a remote control transmitter that is typically used for garage door openers. Examples of such trainable RF transmitters are disclosed in U.S. Patent Nos. 5,442,340, 5,479,155, 5,583,485, 5,614,885, and 5,614,891. These trainable transmitters, which are typically installed in the interior of a vehicle, store data representing the learned signal characteristics such that they may subsequently transmit a modulated RF signal having the learned characteristics to a receiver that responds to the transmitted signal by performing a control operation such as opening a garage door or security gate.

By integrating a trainable transmitter of this type in a vehicle, the original remote control garage door transmitter may be replaced by such a trainable transmitter after it is used to train the vehicle's trainable transmitter. In this manner, the somewhat unsightly original remote transmitters need no longer be clipped to the vehicle's visor where they may pose a safety hazard. Because such trainable transmitters are typically sold as an OEM product and installed in the vehicle by the vehicle manufacturer, the trainable transmitters may be unobtrusively integrated within a vehicle accessory such as a sun visor, rear view mirror, or overhead console.

An additional use for a trainable RF transmitter provides a system in which a trainable RF transmitter is used to transmit an RF signal to an RF receiver in a control module that responds by transmitting a control signal through household AC power lines

to a remote module associated with a household appliance such as a light. The remote module responds to the control signal by controlling the operation of the appliance.

Further, by including the structure of the trainable transmitter in a vehicle and providing access by the transmitter's microcontroller to the vehicle control bus, the receiver circuitry included in the trainable transmitter for receiving a signal in the training mode, may be used in a remote keyless entry (RKE) system to receive an RF control signal from an associated key fob transmitter. The microcontroller may be programmed to respond to the RKE control signal by generating and supplying a lock/unlock command to the vehicle's door locks. Additionally, the vehicle's security system may also be enabled/disabled with the locking/unlocking of the doors. With such an implementation, a second receiver dedicated to receiving RKE control signals is no longer required thereby resulting in a significant reduction in vehicle manufacturing costs. Examples of trainable transmitters used in this manner are disclosed in U.S. Patent Nos. 5,614,885; 5,619,190; 5,627,529; and 5,646,701.

Another use for a vehicle-installed trainable transmitter is disclosed in U.S. Patent No. 5,661,651, issued on August 26, 1997, and entitled WIRELESS VEHICLE PARAMETER MONITORING SYSTEM. In that application, the receiver portion of a vehicle-installed trainable transmitter is used to receive RF signals including vehicle parameter information, such as the pressure in each of the vehicle's tires. If the sensed vehicle parameter reaches a dangerous level, an alarm or displayed message may be generated to warn the driver of the dangerous condition.

In all the above-noted uses of trainable RF transmitters, the trainable transmitters are trained to learn a code that represents an access number or control code shared by each transmitter associated with the system. In other words, the transmitted codes are used by any of the individuals having a transmitter associated with the responding system. Such systems do not, however, require the transmission of an RF signal specifically identifying any of the occupants of the vehicle or any particular person authorized to use the system.

Having generally described the background of the invention relative to known uses for trainable RF transmitters, a general description of the background relative to some of the systems and environments are described below in which new applications for trainable RF transmitters are now provided in accordance with the present invention.

Conventional security systems typically have used either a key, a pass card with a magnetic strip, or a keypad for entry of a shared access code into the security system, which responds by allowing access or ingress into a secured area. Such secured areas may include a building, a home, a fenced outside area, a car, a garage, or a particular room or rooms within a building as a few examples.

Security systems also exist which utilize a portable RF transponder circuit that transmits an RF signal including a shared access code or a personal identification code when interrogated by a system transmitter. The transmitted access/identification code is received and analyzed by a system receiver that is associated with a particular point of access to the secured area, such as a doorway or gate. Some of these RF identification systems solely use shared access codes whereby the portable transponders carried by individuals transmit an access code representing the security level of those individuals. Such systems typically permit entry by an individual to those areas that accept the particular access code transmitted from the individual's transponder.

Other systems use identification codes that are uniquely associated with individuals having clearance to enter a secured area in the security system. In these systems, each secured area may include a memory device for storing a separate list of identification codes corresponding to those individuals that are allowed to enter that secured area.

Regardless of whether the system utilizes a pass code or an identification code, however, such RF security systems suffer from the same problem that other security systems of this type suffer, namely, the potential that an RF transponder, key, or pass card may be stolen and used by an unauthorized person to gain entry to a secured area. To prevent such unauthorized entry, security guards are often required to be positioned at the main entry points of the secured area to check the identification of the individuals seeking entry to ensure that the person bearing an identification card is, in fact, identified in the identification card. When security guards are required for checking identification in this manner, the above-mentioned RF security systems do not provide any significant advantage or added security.

RF security systems of the type noted above are also employed in vehicle RKE systems. Vehicle RKE systems have become quite common, often resulting in the need

for individuals with more than one vehicle to carry two or more of these bulky key fob transmitters on a single key chain. If the individual carrying such key fobs works for a company having a security system that utilizes RF identification transponders and lives in an apartment complex utilizing a security system that also uses RF identification transponders, the individual may have to carry four or more transmitters at any one time thereby making such transmitters a burden to carry.

Another environment affected by the present invention is that of paying tolls. Current methods of paying tolls for use of a road or bridge include the establishment of toll booths at various locations along the road and/or at entrances and/or exits of the road or bridge. Such toll booths may simply provide a shelter for personnel responsible for manually collecting money or handing out fare cards to the drivers of the vehicles passing therethrough, or the toll booths may include some form of automated equipment for collecting money and/or supplying/receiving fare cards. With such toll booths, however, vehicles are required to significantly slow down or stop to transact with the person or machine in the toll booth. Such transactions may involve receiving a fare card, paying the fare by handing money to a toll booth operator and receiving any change, or throwing money in a basket of an automated fare collecting device. Such stopping of each vehicle, frequently causes undesirable traffic back-ups.

In an effort to reduce such traffic back-ups, an RF system has been developed whereby a number of radio receivers suspended over the roadway communicate with RF transponder units placed on the instrument panels of the vehicles. When interrogated, the transponders transmit a unique code assigned to that unit to the system receivers, which respond by debiting a pre-paid account of the person leasing the transponder unit. With this system, drivers do not need to slow down or stop to pay tolls, and therefore, no additional traffic back-ups result. By requiring drivers to place a loose transponder in the vehicle, however, a safety hazard is created, not to mention the nuisance of having an unsightly piece of equipment sliding around. Moreover, it is conceivable that such transponder units may be stolen from the vehicles and subsequently used to consume the balance of the pre-paid account associated with that transponder. Further, the above-described system could not be used in the type of toll collection systems in which a fare card is handed to the driver at the entrance of a toll road and subsequently handed to a toll

operator at the desired exit for the purpose of determining a variable fare rate. Additionally, the unique code transmitted from the transponder unit is, in reality, associated with the transponder itself rather than with the user insofar as the unique code would not be useful in other types of systems for identifying either the user or a universally-recognized account for the user. Therefore, the transponder unit could not be universally used in other types of systems that could respond to the receipt of a code uniquely associated with an individual.

Another environment for a trainable transmitter of the system of the present invention involves the payment of fees, and more particularly, the payment of fees for services associated with the vehicle or for services not associated with the vehicle, but provided to individuals within, or in proximity to, their vehicle. Such services include car washes, the supply of fuel, and the supply of food and beverages at a drive-through restaurant. Another example is the payment of parking fees to either a parking meter or to an individual or apparatus at a collection booth. In such environments, the driver or other vehicle occupant has in the past had to search within the close confines of the vehicle for their wallet, credit card, sufficient change, etc., to make the appropriate payment.

SUMMARY OF THE INVENTION

An aspect of the present invention is to provide a system and method whereby a single trainable transmitter may be universally used to properly interact with all the above types of systems and in all the above environments.

Another aspect of the present invention is to provide a method of using a trainable transmitter to transmit an RF signal including a code uniquely identifying an individual or an individual's universally-recognized account, such as a credit card number such that various different systems equipped with an RF receiver may accept payment by the transmission of such a signal from such a trainable transmitter. Still another aspect of the present invention is to provide a vehicle-installed trainable RF transmitter for transmitting an individual's credit account number in an RF signal for remote billing of various expenses such as parking fees, toll fares, fuel expenses, and the cost of food purchased from a drive-through restaurant.

Yet another aspect of the present invention is to provide a portable transmitter that is trainable to the characteristics of a plurality of identification/access codes to allow the

use of a single portable transmitter to transmit RF signals to a plurality of receivers of different security systems. A further aspect is to provide a trainable RF transmitter in a key fob that is trainable to a plurality of access codes for a plurality of vehicles.

To achieve these and other aspects and advantages, the present invention uses a trainable transmitter that is operable in a training mode to learn the RF carrier frequency and code of a received signal and operable in a transmitting mode to transmit a signal having the learned RF carrier frequency and code of a received signal. A method according to one aspect of the invention comprises the steps of training the trainable transmitter to learn the RF carrier frequency and code of a training signal transmitted from a separate transmitter, the code included in the training signal being a unique personal identification code associated with an individual, and transmitting an RF signal from the trainable transmitter including the learned RF carrier frequency and identification code, to a receiver that analyzes the received identification code and responds thereto by performing a specific task relative to the individual identified in the personal identification code.

The receiver to which the trainable transmitter transmits the learned RF signal may be a receiver in a security system, wherein the specific task performed by the receiver in response to the received identification code is to disable the security system. Alternatively or additionally, the receiver to which the trainable transmitter transmits the learned RF signal may be installed in a parking meter, and the task performed by the receiver in response to the received identification code is to debit an account of the individual identified in the identification code. Further, the receiver to which the trainable transmitter transmits the learned RF signal may be installed along side a toll road or bridge, and the task performed by the receiver in response to the received identification code is to debit an account of the individual identified in the identification code. Moreover, the receiver to which the trainable transmitter transmits the learned RF signal may be installed at a drive-through station of a service center, such as a restaurant or gas station, and the task performed by the receiver in response to the received identification code is to debit an account of the individual identified in the identification code. The trainable transmitter may be installed in a vehicle or provided in a key fob or identification card.

An additional aspect of the present invention is to provide a security system that displays an image of an individual in response to the receipt of an RF signal transmitted from a transmitter associated with that individual. To achieve this and other aspects and advantages, the security system of the present invention comprises a transmitter, which may be a trainable RF transmitter, for transmitting an RF signal including information uniquely associated with an individual, a receiver installed at a security installation for receiving RF signals, a display device provided in the security installation for displaying images to security personnel, and a controller coupled to the receiver and the display device for controlling the display device to display an image of an individual associated with the information included in an RF signal received by the receiver.

These and other features, advantages and objects of the present invention will be further understood and appreciated by those skilled in the art by reference to the following specification, claims, and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a pictorial view of a vehicle including a transmitter according to the present invention;

Fig. 2 is a front perspective view of a transmitter housing according to the invention;

Fig. 3 is a rear perspective view of a transmitter housing according to Fig. 2;

Fig. 4 is a fragmentary perspective view of a vehicle interior having an overhead console for housing the trainable transmitter of the present invention;

Fig. 5 is a perspective view of a visor incorporating the trainable transmitter of the present invention;

Fig. 6 is a perspective view of a rearview mirror assembly incorporating the trainable transmitter of the present invention;

Fig. 7 is a circuit diagram in block form of the transmitter according to the present invention;

Fig. 8 is a flow diagram of the program for controlling the operation of the transmitter shown in Fig. 7;

Fig. 9 is a circuit diagram in block form of the system receiver shown in Fig. 7;

Fig. 10 is a pictorial and block diagram view of an electrical system employing an identification card including a trainable transmitter according to the present invention;

Fig. 11 is a pictorial view of a key fob and block diagram of an electrical system including a trainable transmitter according to the present invention; and

Fig. 12 is an electrical circuit in block diagram form illustrating the applications of a trainable transmitter according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring initially to Fig. 1, a vehicle 8 is shown incorporating a trainable transmitter 55 in accordance with the present invention. As will be described in more detail below, the trainable transmitter 55 selectively transmits a coded RF signal, as indicated by arrow "T" to a device controlled by an RF control signal, such as garage door opening mechanism 14 shown in block form in Fig. 1. The conventional garage door opening mechanism 14 includes a receiver and a control circuit (not shown) which responds to the control signal "T" for opening and closing a garage door. The trainable transmitter 55 typically includes a receiver portion which may be controlled to receive a coded RF signal "K" from a key fob transmitter 22 to which the receiver responds by performing a predesignated function such as locking or unlocking the doors of the vehicle.

Trainable transmitter 55 may take several forms for installation in a vehicle. As shown in Figs. 2 and 3, the trainable transmitter 55 may be mounted in a rectangular housing 40 which preferably is installed permanently or removably in an accessory of the vehicle. For example, as shown in Fig. 4, trainable transmitter 55 may be provided in an overhead console 50, which may further include map lamps 52 and map lamp switches 54, or other components such as a compass, trip computer, and/or display. As shown in Figs. 5 and 6, trainable transmitter 55 may be included in a visor 51 or a rear view mirror 53. As shown in Figs. 2-6, and described in more detail below, trainable transmitter 55 preferably includes three or more push-button switches 44, 46, and 47, and an indicator 48, which may be an LED or an alphanumeric or graphic display. The three or more push-buttons are provided to enable a user to train the transmitter to a plurality of signals associated with each of the push-button switches so that the user may subsequently cause trainable transmitter 55 to transmit a learned signal in response to the actuation of the

associated push-button switch. As shown in Fig. 3 and further described with respect to Fig. 7, trainable transmitter 55 may be provided with either a serial or parallel port 42 for connecting to a vehicle control bus 43, which enables trainable transmitter 55 to perform operations in response to signals received by its receiver portion, such as locking or unlocking the vehicle doors.

Fig. 7 shows the general components forming trainable transmitter 55 of the present invention. Trainable transmitter 55 preferably includes a microcontroller 57 coupled to receive input signals from a user interface 49 to which microcontroller 57 responds by performing predetermined tasks. User interface 49 generally consists of a plurality of push-button switches, such as switches 44, 46, and 47, shown in Figs. 2-6. Alternatively, user interface 49 may be constructed in accordance with the user interface disclosed in U.S. Patent No. 5,555,172 issued September 10, 1996, and entitled USER INTERFACE FOR CONTROLLING ACCESSORIES AND ENTERING DATA IN A VEHICLE, whereby a display device, such as an alpha-numeric display device 48 shown in Fig. 7, is used to display selectable operations that may be changed or selected by manipulation of one or more switches associated with the user interface. In using such a user interface, trainable transmitter 55 may be trained to any number of RF signal characteristics provided there is sufficient memory for storing the characteristics of each signal. The user interface would then enable a user to select from these numerous learned RF signals through a menu structure that is displayed on the display device or by pressing an associated push-button switch provided in addition to such a user interface.

Trainable transmitter 55 further includes an RF transceiver circuit 58 that is coupled to, and operated under control of, microcontroller 57. RF transceiver circuit 58 is coupled to an antenna 59 which is used to transmit control signals "T" to receivers of other systems 66 and to receive control signals "K" from a key fob 22 (Fig. 1) and RF control signals "B" from remote transmitters 65 during a training sequence.

As described in more detail below, microcontroller 57 and RF receiver circuit 58 cooperate to receive a control signal "B" and identify its RF carrier frequency, code, and modulation scheme during a training mode. The learned RF carrier frequency, code, and modulation scheme for each received signal are stored in a memory device 62, which may be included within microcontroller 57 or coupled externally thereto. During a

transmitting mode, which is entered into in response to an actuation of a switch in interface 49, microcontroller 57 reads the associated RF carrier frequency, code, and modulation scheme data from memory 62 and supplies the data to RF transceiver circuit 58, which transmits an RF signal having the learned characteristics through antenna 59.

As mentioned above, trainable transmitter 55 may include a vehicle bus port 42 coupled to microcontroller 57 through a vehicle bus interface 41 for connecting trainable transmitter 55 to a vehicle bus 43. Vehicle bus interface 41 is provided to enable microcontroller 57 to send and receive control signals to and from vehicle bus 43 in response to command signals from user interface 49 or command signals received through antenna 59 and RF receiver circuit 58.

Trainable transmitter 55 further includes a power supply circuit 56 which supplies power to the various components of trainable transmitter 55. Power supply 56 may include an internal battery and/or may include a connector 61 for coupling power supply 56 to an external battery 60, which may be the battery of a vehicle in which trainable transmitter 55 is installed. It will be appreciated by those skilled in the art, that if trainable transmitter 55 is provided as a portable device, power supply 56 would include a replaceable battery and would not require a connector 61. Further, vehicle bus interface 41 and port 42 would also not be required if trainable transmitter 55 were implemented in a portable hand-carried device, such as an identification card or a key fob.

Having described the general components forming the trainable transmitter of the present invention, the general operation thereof is described below with reference to Fig. 8. As shown in Fig. 8, the process 200 performed by microcontroller 57 begins in step 202 when microcontroller 57 is either initially powered-up or reset. Microcontroller 57 begins the process by checking whether any switches are pressed or if any commands are otherwise received from user interface 49. If no input is received from user interface 49, microcontroller 57 enters a receiving mode in step 206 in which it determines in step 208 whether any incoming signal is being received through antenna 59. If no incoming signal is currently being received, microcontroller 57 sets up a sleep timer in step 210 and enters a sleeping mode in step 212 to prevent undue drainage of the battery. A sleep timing circuit external to microcontroller 57 periodically generates a wake-up signal to interrupt the sleep mode of microcontroller 57. When an external timer interrupt is received from

the sleep timer (step 214), microcontroller 57 returns to step 204 to determine whether any input has been received from user interface 49. The process as described above is repeated until microcontroller 57 detects that an input from user interface 49 has been received in step 204 or if microcontroller 57 determines that an incoming signal is being received in step 208.

If an incoming signal is being received, microcontroller 57 detects this in step 208 and subsequently determines whether the incoming signal represents a signal to which microcontroller 57 is required to respond (step 216) by comparing the received code with the codes prestored in memory 62. If no response is required, microcontroller 57 re-enters the sleep state until an external timer interrupt is received. If, on the other hand, the received signal includes a code that microcontroller 57 recognizes as requiring a response, microcontroller 57 performs the appropriate response in step 218 and then re-enters the sleep mode. An example of such an appropriate response may be to lock or unlock the vehicle's doors when a signal is received from a key fob 22. As will be described below, the code of the signal from the key fob as well as the carrier frequency and modulation scheme, may be prestored in memory 62 for microcontroller 57 to compare to the code in a received signal, or a code, RF frequency, and modulation scheme may be learned during a training sequence. By training trainable transmitter 55 to the characteristics of a signal from a key fob, microcontroller 57 may be trained to respond to perform a function such as locking or unlocking the vehicle's doors in response to signals from different key fobs. Thus, an individual having two vehicles with RKE systems, may use a single key fob to remotely actuate the vehicle locks (or initiate some other vehicle function) of both vehicles thereby eliminating the need for the individual to carry two separate key fobs for each vehicle.

In the event that microcontroller 57 detects that a switch within user interface 49 has been pressed (step 204), microcontroller 57 enters a transmitting mode (step 220) in which it transfers the RF frequency, code, and modulation scheme data stored in a location of memory 62 associated with the pressed switch, to RF transceiver circuit 58. RF transceiver circuit 58 responds by transmitting an RF signal having the carrier frequency, code, and modulation scheme to a remote receiver (step 222). Such a receiver may take many forms and be provided as a component in one of many different types of

systems in accordance with the present invention. For example, the receiver may be provided in a garage door opening mechanism, a control module connected to the AC wiring in a house for controlling household appliances, a security system, a roadside toll booth, a gas pump, an automatic teller machine, a drive-through restaurant, or a parking meter, as will be described in more detail below.

In step 224, microcontroller 57 determines whether the switch in user interface 49 is still pressed. If the switch is no longer pressed, microcontroller 57 returns to the receiving mode and checks whether any incoming RF signal is being received (step 208). If the switch is still depressed, microcontroller 57 determines in step 226 whether the switch has been pressed for a predetermined time period. If the switch is released prior to this time period, microcontroller 57 checks whether any incoming signal is being received in step 208 as described above. If the switch has been pressed for the predetermined period of time, microcontroller 57 performs the training sequence in step 228. The specifics of the training sequence are known and described in U.S. Patent Nos. 5,479,155; 5,583,485; 5,442,340; 5,614,885; 5,614,891; and 5,619,190, as are the detailed constructions of various embodiments of trainable transmitter circuits. When the training sequence is complete (step 230), microcontroller 57 performs step 208 by determining whether any incoming signals are being received. The process as described above is then repeatedly performed so long as power is supplied to trainable transmitter 55.

As will be apparent from the following description of the preferred methods of use for the trainable transmitter described above, various steps in the process described above with respect to Fig. 8 may be eliminated. In particular, the steps associated with the receiving mode (steps 206, 208, 210, 216, and 218) may be eliminated such that microcontroller 57 remains in a sleep mode until one of the switches has been activated. Further, in the various embodiments described below, the receiver portion of RF transceiver circuit 58 could be eliminated and user interface 49 could be configured with a serial or parallel port through which the RF carrier frequency, code, and modulation scheme for one or more signals may be downloaded through microcontroller 57 into memory 62 for subsequent transmittal upon the actuation of an associated switch or receipt of an interrogation signal. Such a configuration may be desirable when trainable

transmitter 55 is implemented in a key fob or identification card in the manner described below.

As shown in Figs. 10 and 11, trainable transmitter 55 may be implemented in an identification tag/card 100 or a key fob 110 so as to transmit a modulated RF signal "T" to an antenna 70 of a system receiver 66. The characteristics of transmitted signal "T" may be learned from a signal "B" transmitted from a separate remote transmitter 65, which may include DIP switches for selecting the unique code. Alternatively, the characteristics could otherwise be downloaded into the memory of trainable transmitter 55.

As shown in Fig. 10, trainable transmitter 55 may be mounted to the back of an identification card 100 with one or more user-actuatable switches 44 and 46 passing through two apertures in the card so as to be accessible on the front of the card for actuation by the person carrying the identification card. Alternatively, if the system with which the identification card 100 is being used includes an interrogating transmitter, user-actuatable switches 44 and 46 may be eliminated and the microcontroller of trainable transmitter 55 may be programmed to respond to an interrogation signal by transmitting the signal "T." By providing a trainable transmitter 55 on identification card 100 in this manner, the identification card may be used for a plurality of other purposes, such as providing an identification to a home security system in addition to the security system at work, and/or transmitting a RKE control signal to the person's vehicle thereby eliminating the need to carry multiple identification card and key fobs. Further, one of the channels in trainable transmitter 55 on the identification card 100 could be trained to learn the signal characteristics to which an automatic teller machine (ATM) would respond by allowing transactions to that person's bank account.

It will be appreciated by those skilled in the art, that identification card 100 could have various configurations as may the mounting of trainable transmitter 55 on such an identification card. Further, it will be appreciated that user-actuatable switches 44 and 46 may be configured in a manner different from that shown in Fig. 10, that additional user-actuated switches may be provided, and that the user-actuatable switches may be eliminated in their entirety provided trainable transmitter 55 may otherwise be caused to transmit a signal including the appropriate code.

Fig. 11 shows the implementation of a trainable RF transmitter within a key fob 110 that may be attached to a key ring 115. Trainable key fob 110 may be used in the same manner as discussed above with respect to the identification card 100 in that it may be trained to transmit a number of different control or identification signals to a number of different systems. For example, trainable key fob 110 may be trained to transmit different RKE control signals to different vehicles such that only a single key fob needs to be carried by a person owning and/or operating more than one vehicle having an RKE system. Further, the trainable transmitter within key fob 110 may likewise be trained to transmit many other signals such as an identification signal that may be transmitted to a security system or a signal including the individual's credit card account number or ATM machine PIN (personal identification number) number for financial transaction purposes. Again, although key fob 110 is shown in Fig. 11 as including three user-actuatable switches 44, 46, and 47, additional switches may be provided or other forms of user input switches could be used without departing from the spirit and scope of the present invention. Also, the microcontroller associated with the trainable transmitter in the fob can be programmed to transmit different signals upon multiple actuations of a single switch.

To understand how some of the various systems in which the trainable transmitter may be used and would respond to the receipt of an RF personal identification signal, reference is now made to Figs. 9 and 12. As shown in Fig. 12, trainable transmitter 55, which may be implemented in any of the various structures discussed above, may be used to transmit signals to, or receive signals from, system receivers and transceivers implemented in an ATM 121, a parking meter 122, a drive-through service center 123, a toll booth 124, a gas pump 125, a security system 126, and/or a telephone 127.

To explain how a receiver 66 may be implemented in these various systems, reference is made to Fig. 9 in which a block diagram of an exemplary receiver is illustrated. As shown, system receiver 66 includes an antenna 70 coupled to a receiver circuit 71, which in turn is coupled to a microcontroller 72. In a typical receiver system, receiver circuit 71 filters out the signals falling within predetermined frequency bands and demodulates these signals to supply the code within the signal to microcontroller 72. Microcontroller 72 would typically then access a database within memory 74 to determine

if the code corresponds to a valid prestored code. If the received code is valid, microcontroller 72 would perform a predetermined task, such as debiting an account identified within the received code by an amount corresponding to a particular fee that is charged or enable another device to perform a function, such as to pump gas or enable a bank transaction. Receiver system 66 may further include a display 73 for displaying prompting messages and the like to the user or to a party remotely located from the user, and an input device 75, which may be located where the user may optionally or additionally input information or located remotely for access by a third party. Further, the system will typically include some form of system interface 76 which links the receiver system 66 to other centralized systems that accumulate information and perform other tasks such as sending out invoices and/or collecting fees.

When the method of the present invention is implemented in a gas pump 125, it will be appreciated that, to the extent existing gas pumps are already equipped with systems that receive a credit card number through a magnetic card reader, these pumps only need to be modified so as to include a receiver as an alternative or additional means for receiving a person's credit card number. With this exception, no other modifications would otherwise be required to the gas pumps to allow for implementation of the present invention. By implementing the methodology of the present invention as a gas pump, a driver need not carry or search for their credit card prior to using the gas pump.

With respect to ATMs, such machines, like the gas pumps, are configured to receive a code identifying the bank account and a PIN number via a card reader and an input keypad, and therefore, the only modification that would be required to implement the present invention in an ATM is to provide a receiver as an alternate means for inputting this information. By implementing the present invention in an ATM, individuals do not need to carry and search for their ATM card to use the ATM. This is particularly advantageous in a drive-up ATM.

With respect to the implementation of the present invention in a drive-through service center 123, such as a drive-through restaurant, the system could be implemented in a manner quite similar to those systems used in grocery stores that accept credit cards by reading the number on the magnetic strip when it is passed through a reader. The only modification to such a system would be to either replace or add an RF receiver as an

additional means for the input of a person's credit card number regarding the particular transaction being performed. By utilizing the inventive method in a drive-through service center, drivers no longer need to search their vehicles for change to pay for food or other goods or services at such drive-through service centers. Instead, a driver may simply press a button conveniently located on an interior vehicle accessory, such as an overhead console.

For implementation of the invention in a toll booth, such as those provided along a roadside or at the entrance or exit to a bridge, the trainable transmitter 55 may be installed in a vehicle in a manner similar to that shown in Figs. 4-6, and trained to transmit the signal that is transmitted by a conventional transponder unit in response to a learned interrogation signal for use in the conventional RF toll system described above. Alternatively, the RF toll system infrastructure could be modified to accept a credit card number that may be transmitted from a trainable transmitter in response to either the actuation of a switch or the receipt of an interrogation signal. In the event that a switch must be actuated to transmit the appropriate code to the receiver in the RF toll system, roadside signs may be posted to prompt the user to press the appropriate button when in the vicinity of a receiver. When implemented in a toll system of the type in which a motorist is issued a fare card when entering the toll road for purposes of determining the appropriate fare when exiting, the trainable transmitter 55 may be operated to transmit an appropriate signal to a receiver at an entrance to the toll road to register the vehicle with respect to that entrance point, and then to subsequently transmit an appropriate signal to a receiver at an exit of the toll road at which point the toll system may access a central database to determine both the entrance and exit points, calculate the appropriate fare, and automatically debit the person's credit card account or other prepaid account by an amount equal to the calculated fare. As with the conventional RF toll system, video cameras may be placed at the entrance and exit locations to identify drivers who failed to cooperate by controlling their trainable transmitters to transmit the appropriate signals at the appropriate locations. Thus, by using a trainable RF transmitter in such a toll collection system, drivers need not contend with a loose, unsightly transponder unit in their vehicle.

In a similar manner to that discussed above with respect to the toll system, the present invention may be implemented in a parking lot/ramp facility whereby trainable

transmitter 55 would be operated to transmit an appropriate signal upon the entry into the parking facility and to subsequently transmit an appropriate signal upon the exit from the facility such that the drivers may be charged by an amount corresponding to the time in which the vehicle has been parked within the lot.

In a similar application, trainable transmitter 55 could be used to transmit an account number or other information to a receiver in a parking meter 122. It is contemplated that a parking meter 122 with which the present invention could be utilized would include a receiver system similar to system receiver 66 shown in Fig. 9 with display device 73 being a digital display of the type used in conventional parking meters, and with input device 75 corresponding to a coin-receiving slot and turn knob as found on conventional parking meters to allow for the receipt of coins in the conventional manner. Parking meter 122 would further include a system interface 76, which may be connected to a central location via a cable or other RF communication link to transmit account transactions to a central facility for purposes of billing. Alternatively, system interface 76 could be a communication port to which a portable device may be connected to download information collected and stored in memory 74 for subsequent downloading to a central facility. In this manner, the personnel responsible for collecting the coins in the meter, may at the same time collect account transaction information that had been stored in memory during the period from the last time that the coins and account information were retrieved.

In operation, when a driver pulls up to a parking meter, the driver would actuate trainable transmitter 55 to transmit a low-power RF signal including a unique identification code to a receiver provided in the closest parking meter 122. Upon receipt of such a signal, microcontroller 72 would determine whether the received code is in one of a plurality of recognized formats for a credit card number or other account number. If the received code has a valid format, microcontroller 72 would record the account number in memory 74 along with the time and date at which the signal was received. Microcontroller 72 would then wait for the subsequent receipt of the identical signal when the driver is pulling away from the parking meter to record that time and date in memory 74 in association with that account number. Alternatively, a transmitter in parking meter 122 may periodically interrogate the vehicle's trainable transmitter until no response is

received, thereby indicating that the vehicle is no longer parked in the associated space. Microcontroller 72 may be programmed to compute the appropriate parking fare based upon the length of time the vehicle was parked, or the computer at the central facility may be programmed to calculate these fares once the times have been downloaded or otherwise supplied thereto from the parking meters. Further, microcontroller 72 may be programmed so as to display on display 73 a message that a valid signal had been received and that the meter is in use such that a police officer or other personnel may determine whether or not the appropriate fee has been or will be paid by the driver/owner of the parked vehicle. Further, when the identical signal is subsequently received to signal the departure of the parked vehicle, the parking meter may be cleared such that the driver may confirm that the parking meter has received the signal and is no longer running up the parking fare. In addition, microcontroller 72 may be programmed to display an "expired" message when a time limit for parking in the associated parking space has expired or when the amount of parking time purchased by the deposit of coins in input device 75 has otherwise elapsed.

By providing such receiver systems in parking meters and implementing the system of the present invention, not only will the likelihood that the parking fare will be received by the managing facility be increased, but the users will benefit by not having to search for enough coins in their vehicles or on their person in order to feed the parking meter enough coins to provide the desired amount of parking time.

In yet another implementation of the present invention, the above methodology may be used as a means for inputting an individual's credit card number into a telephone. Like conventional gas pumps and ATMs, existing telephones include means for reading a credit card number from the magnetic strip on a credit card. Therefore, to implement the present invention, the only modification that would need to be made is to provide a receiver as an alternative or additional means for inputting the credit card number to the telephone.

To implement the present invention in an existing RF security system, all that would need to be done is to train a trainable transmitter 55 that is carried by the individual to the access code or identification code to which the receivers in the security system respond. Additionally, if the trainable transmitter is to transmit its signal in response to an

interrogation signal, the controller of the trainable transmitter would be reprogrammed so as to learn not only the characteristics of the signal that it must transmit to the security system, but also the characteristics of the interrogation signal such that when an interrogation signal is received, trainable transmitter 55 would recognize it and respond by transmitting a signal having the learned characteristics of the identification/access code to which the security system will respond.

In accordance with another embodiment of the present invention, a security system may be implemented that responds to the access/identification signal transmitted by an individual from either a portable transmitter or a transmitter installed in a vehicle, by causing an image of the particular individual associated with that signal to be displayed on a display such as a CRT 73 at a security installation such as a gate house, or central facility. In such a security system, the images may be previously stored in a memory device, such as memory 74 (Fig. 9) so that the receiving system 66 may look up the previously-stored image that corresponds to the received identification signal and display it on display 73. Alternatively, the image data may be included in the transmitted identification signal.

By providing a security system that displays a previously-stored image of the individual, security personnel may be able to quickly confirm the identity of the person seeking entry by viewing the person directly or indirectly through a video camera located at the entrance point, and by viewing the displayed image. In this manner, a security guard need not necessarily be located in a remote gate house and does not need to walk out to a vehicle to view an image on a small identification card held by the driver of the vehicle. Thus, a number of security gate houses may be monitored in a central facility by relatively few security guards who would compare images of the driver obtained through a remote camera with a displayed image and, if the guard can confirm the identity of the person seeking entry, the guard could then activate a switch that opens the gate or doorway.

It will be apparent to those skilled in the art, that the trainable transmitter as used in these various systems, may be either implemented in a portable form or installed in a vehicle. Further, although the present invention has been described separately with respect to various types of systems, it will be appreciated that a single trainable transmitter

may be used to transmit a signal to all or any combination of the various systems disclosed. For example, if trainable transmitter 55 (Fig. 12) were trained to transmit an individual's credit card number and the various systems were provided with a receiver for processing such a signal, trainable transmitter 55 could readily be used to transmit signals to all of these systems as well as to other systems not disclosed that accept a credit card number through conventional electronic means.

To the extent that an individual typically carries their own set of keys and their own identification cards, it would be unlikely that more than one individual would utilize any one trainable key fob or identification card such that the trainable transmitters need only be trained to a single person's identification number. On the other hand, for a trainable transmitter that is installed in a vehicle, more than one individual may operate the vehicle. Therefore, it would be necessary to train the trainable transmitter to transmit more than one identification code. In some implementations of trainable transmitters, this may not present a problem. However, if the number of trainable channels are limited to the number of user-actuatable switches, for example, one may not wish to dedicate more than one channel for the transmission of an identification code. To allow more than one identification code to be transmitted from such a trainable transmitter without using more than one channel, the trainable transmitter may be programmed so as to identify which individual is currently driving the vehicle based upon the actuation of a driver identification switch or based upon the receipt of a driver number code included in an RKE unlock signal so as to retrieve from memory the appropriate identification number for the one channel used for transmitting that number which corresponds to the current driver.

It will be appreciated by those skilled in the art, that the transmitted identification code may be, and preferably is, encrypted during transmission to prevent an unauthorized person from identifying and grabbing the transmitted code. Moreover, in some of the above-noted systems, it is possible to implement a rolling code algorithm such that a portion of the code transmitted with the identification signal varies with each transmission.

The above description is considered that of the preferred embodiments only. Modifications of the invention will occur to those skilled in the art and to those who make

or use the invention. Therefore, it is understood that the embodiments shown in the drawings and described above are merely for illustrative purposes and not intended to limit the scope of the invention, which is defined by the following claims as interpreted according to the principles of patent law, including the doctrine of equivalents.

CLAIMS

1. A method of using a trainable transmitter operable in a training mode to learn the RF carrier frequency and code of a received signal and operable in a transmitting mode to transmit a signal having the learned RF carrier frequency and code of a received signal, said method comprising the steps of:

training said trainable transmitter to learn the RF carrier frequency and code of a training signal transmitted from a separate transmitter, the code included in the training signal being a personal identification code uniquely associated with an individual; and

transmitting an RF signal from said trainable transmitter including the learned RF carrier frequency and personal identification code, to a receiver that analyzes the received personal identification code and responds thereto by performing a specific task relative to the individual uniquely identified by the personal identification code.

2. The method as defined in claim 1, wherein the receiver to which said trainable transmitter transmits the learned RF signal is a receiver in a security system.

3. The method as defined in claim 2, wherein the specific task performed by the receiver in response to the received identification code is to disable the security system.

4. The method as defined in claim 2, wherein the specific task performed by the receiver in response to the received identification code is to instruct the security system to allow access by the individual identified in the received personal identification code.

5. The method as defined in claim 1, wherein the receiver to which said trainable transmitter transmits the learned RF signal is installed at a parking location, and the task performed by the receiver in response to the received identification code is to debit an account of the individual identified in the personal identification code.

6. The method as defined in claim 1, wherein the receiver to which said trainable transmitter transmits the learned RF signal is installed along a toll road, and the task performed by the receiver in response to the received identification code is to debit an account of the individual identified in the personal identification code.

7. The method as defined in claim 6, wherein the receiver is installed at the entrance to a toll bridge.

8. The method as defined in claim 1, wherein the receiver to which said trainable transmitter transmits the learned RF signal is installed at a drive-through station of a service center, and the task performed by the receiver in response to the received identification code is to debit an account of the individual identified in the personal identification code.

9. The method as defined in claim 8, wherein the service center is a gas station and the receiver debits the individual's account by an amount equal to the cost for gasoline delivered from a gas pump.

10. The method as defined in claim 8, wherein the service center is a drive-through restaurant and the receiver debits the individual's account by an amount equal to the cost for food purchased by the individual.

11. The method as defined in claim 1, wherein said trainable transmitter is installed in a vehicle.

12. The method as defined in claim 1, wherein said trainable transmitter is provided in a key fob.

13. A security system comprising:

a transmitter for transmitting an RF signal including personal identification information uniquely associated with an individual;

a receiver installed at a security installation for receiving RF signals;

a display provided in the security installation for displaying images to security personnel; and

a controller coupled to said receiver and said display device for controlling said display device to display an image of an individual associated with the personal identification information included in an RF signal received by said receiver.

14. The security system as defined in claim 13 and further including a memory coupled to said controller for storing images of a plurality of individuals, wherein the personal identification information included in each RF signal includes a unique personal identification code associated with an individual, and said controller responds to the receipt of an RF signal by accessing said memory to provide an image to said display device of an individual that is associated with the personal identification code in the received RF signal.

15. The security system as defined in claim 13, wherein said transmitter is a trainable transmitter that is trained to transmit an RF signal including personal identification information that is input into said trainable transmitter and which is uniquely associated with an individual.

16. The security system as defined in claim 15, wherein said trainable transmitter is trained to the personal identification information uniquely associated with an individual by receiving a training signal including the personal identification information and storing the received information.

17. The security system as defined in claim 16, wherein said trainable transmitter is trainable to the RF carrier frequency of a received training signal.

18. The security system as defined in claim 17 and further including a second transmitter having input means for entry of a unique personal identification code whereby said second transmitter transmits a training signal to said trainable transmitter having a fixed carrier frequency and a unique personal identification code to which the trainable transmitter may be trained.

19. The security system as defined in claim 17, wherein said receiver filters out all received RF signals except for those having a predetermined carrier frequency, and said trainable transmitter is trained to transmit a signal having the predetermined carrier frequency.

20. The security system as defined in claim 13, wherein said transmitter is installed in a vehicle.

21. The security system as defined in claim 13, wherein said transmitter is a vehicle-installed trainable transmitter including a memory device for prestoring characteristics of a plurality of signals, and a plurality of user-actuated switches for causing said trainable transmitter to transmit one of said plurality of signals.

22. The security system as defined in claim 21, wherein one of said plurality of signals is a signal having characteristics to which a receiver of a garage door opener will respond by opening a garage door.

23. The security system as defined in claim 13, wherein said transmitter includes a user-actuated switch, and said transmitter transmits an RF signal in response to an actuation of said switch.

24. The security system as defined in claim 13, wherein said transmitter is portable such that said transmitter may be carried by the individual whose personal identification information is transmitted therefrom.

25. The security system as defined in claim 24, wherein said portable transmitter is included in a key fob.

26. The security system as defined in claim 24, wherein said portable transmitter is provided on an identification card.

27. A key fob comprising:

a housing adapted to be attached to a key chain; and

an RF trainable transmitter mounted in said housing, said trainable transmitter including:

a memory for storing the RF carrier frequency and code for a plurality of signals, wherein the RF carrier frequency and code for at least one of said signals are pre-stored and correspond to the signal characteristics to which a vehicle-installed receiver responds by controlling at least one door lock on a vehicle,

a plurality of user-actuated switches disposed on said housing, each switch associated with a storage location in said memory,

a controller coupled to said memory and to said plurality of switches, and

a transmitter coupled to said controller for generating and transmitting a modulated RF signal, having an RF carrier frequency and code as determined by said controller, wherein, when one of said switches is actuated, said controller reads the RF carrier frequency and code stored in the storage location of said memory that is associated with said switch and supplies the read RF carrier frequency and code to said transmitter for transmission of a signal having the supplied RF carrier frequency and code.

28. The key fob as defined in claim 27, wherein said trainable transmitter further includes a receiver for receiving an RF signal when said controller is in a training mode, said controller being operable in said training mode to identify and store the RF carrier frequency and code of the received RF signal in said memory at a storage location associated with one of said switches such that, when in a transmitting mode, said controller responds to the actuation of that switch by reading the learned RF carrier frequency and code stored in the storage location of said memory that is associated with that switch and supplies the read RF carrier frequency and code to said transmitter for transmission of a signal having the supplied RF carrier frequency and code.

29. The key fob as defined in claim 27, wherein the RF carrier frequency and code for at least one of said plurality of signals stored in said memory are learned signal characteristics of a signal to which a second vehicle-installed receiver responds by controlling at least one door lock on a second vehicle.

30. The key fob as defined in claim 27, wherein the RF carrier frequency and code for at least one of said plurality of signals stored in said memory are learned signal characteristics of a signal used to uniquely identify an individual to a receiver installed in an automatic teller machine.

31. The key fob as defined in claim 27, wherein the RF carrier frequency and code for at least one of said plurality of signals stored in said memory are learned signal characteristics of a signal used to uniquely identify an individual to a receiver installed in a security system.

32. An RF identification card comprising:

a housing; and

an RF trainable transmitter mounted in said housing, said trainable transmitter including:

a memory for storing the RF carrier frequency and code for at least one signal, the code for at least one signal being a unique personal identification code associated with an individual,

a controller coupled to said memory, and

a variable frequency transmitter coupled to said controller for generating and transmitting a modulated RF signal, having an RF carrier frequency and code determined by said controller,

wherein said controller reads the RF carrier frequency and code stored in said memory and supplies the read RF carrier frequency and code to said transmitter for transmission of a signal having the supplied RF carrier frequency and code.

33. The RF identification card as defined in claim 32, wherein said trainable transmitter further includes a receiver for receiving an RF signal when said controller is in a training mode, said controller being operable in said training mode to identify and store the RF carrier frequency and code of the received RF signal in said memory such that, when in a transmitting mode, said controller reads the learned RF carrier frequency and code stored in said memory and supplies the read RF carrier frequency and code to said transmitter for transmission of a signal having the supplied RF carrier frequency and code.

34. The RF identification card as defined in claim 32, wherein the RF carrier frequency and code for at least one signal stored in said memory are learned signal characteristics of a signal to which a vehicle-installed receiver responds by controlling door locks on a vehicle.

35. The RF identification card as defined in claim 32, wherein the RF carrier frequency and code for at least one signal stored in said memory are learned signal characteristics of a signal used to uniquely identify an individual to a receiver installed in an automatic teller machine.

36. The RF identification card as defined in claim 32, wherein the RF carrier frequency and code for at least one signal stored in said memory are learned signal characteristics of a signal used to uniquely identify an individual to a receiver installed in a security system.

37. A method of using a trainable transmitter, the method being substantially as hereinbefore described with reference to any of the accompanying drawings.

38. A security system substantially as hereinbefore described with reference to any of the accompanying drawings.

39. A key fob substantially as hereinbefore described with reference to any of the accompanying drawings.

40. An RF identification card substantially as hereinbefore described with reference to any of the accompanying drawings.

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G4H (HTG)

Int Cl (Ed.6): G08C, G07C, G07F, E05B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None	

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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